hemiplegia. As the quantity of opium taken was not large enough to cause the death of the patient, its depressing influence passed over after the lapse of some days, and consciousness gradually returned, though the paralysis remained. But even this affection seemed to improve, when a sudden and violent reaction set in, causing delirium, and ending in meningitis and death.

As regards the lesions in the cortical layer of the cerebrum in this case, they were of such a nature as neither to prove nor disprove the theory of the existence of psycho-motor centres in the cortical layer. If my view, regarding the time of occurrence of the capillary hemorrhages, is correct, this case would show on the one hand, that such hemorrhages may take place in these centres without being directly followed by paralysis; but also, on the other hand, that hemiplegia will follow, provided the lesion is sufficiently severe. Thus the first punctiform hemorrhages, which I found surrounded by fibrinous capsules, may have occurred without producing any paralytic symptoms, while the last, occurring at a time when the degeneration of the vessels, as well as that of the nervous elements, had already progressed to a certain degree, produced the hemiplegia at last.

(*To be continued.*)

INVESTIGATIONS ON THE EFFECTS OF PROLONGED MUSCULAR EXERCISE ON THE EXCRETION OF UREA, URIC ACID, PHOSPHORIC ACID, SULPHURIC ACID, AND CHLORIDE OF SODIUM.

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It is important that the physician and physiologist should embrace those comparative rare opportunities in which individuals perform definite mechanical labors in carefully recorded periods of time, for the determination of the amounts of those excrementitious compounds which represent the waste of the blood, and of the muscular and nervous tissues.

The results thus obtained are valuable, as furnishing data for

the proper estimation of the disturbances occasioned in the chemistry of the body by the action of morbific agents in certain diseases.

When the individuals undergoing extraordinary muscular exertion in definite and carefully recorded periods of time, not only consent to the investigation, but also exercise the greatest care to render the results accurate; and when no effort is spared on the part of the chemist to secure the correct determination of the products of the chemical changes of the organs and tissues, by the employment of the most approved instruments and methods of research; the conclusions may be accepted for purposes of comparison with the observations made in other states of the human system, as of rest, variations of diet, starvation, and disease.

Observations on the Urinary Excretion, and especially upon the Amounts of Urea, Uric Acid and Phosphoric Acid, Sulphuric Acid and Chloride of Sodium Excreted in Definite Periods of time, by the Pedestrian Henry Schmehl, during his recent Walk of 500 Miles, in 142 Hours 17 Minutes and 5 Seconds, in St. Patrick's Hall, New Orleans, Louisiana.

Henry Schmehl; native of Germany; age 28 years; weight 145 lbs.; height 5 feet 11 inches; broad shoulders; well-formed limbs; large feet; athletic figure; fair complexion; blue eyes; light hair; pleasant expression of countenance, with determined, well-set mouth, prominent nose, and high cheek bones; good cerebral development. In walking, the stride of the pedestrian measured three feet and nine inches, and the entire body, chest and arms were thrown in motion. The movement of the arms appears to be as great as those of the lower extremities. The legs move with the freedom and ease of those of the dromedary.

Schmehl commenced his walk in St. Patrick's Hall at 9.04 p. m., Monday evening, February 4th, 1878. At 8.05 o'clock, p. m., February 5th, he completed the 100th mile: time, 23 hours 11 minutes; this included over 4½ hours occupied by the pedestrian in sleep and in taking his meals; the actual walking time was about 18 hours. The 100th mile was made in 8 minutes and

5 seconds; the average time for each mile was ten minutes and a half.

At 9½ o'clock p. m., February 6th (Wednesday), Schmehl completed the 180th mile. This was a falling off of 20 miles in the performance of the 1st 24 hours, which was accounted for by the fact that he felt sore about the feet and legs, from his extra exertions on Tuesday, the 5th inst. He made the 169th mile in 8 minutes, by special exertion.

His average continues about 11 minutes per mile. With the exception of some soreness about the feet, his condition and health are good, the pulsations of the heart being not over 98 per minute when at rest.

Commenced collecting the urine of Schmehl on Thursday, February 7th, 11.45 a. m.

Dr. Samuel D. Hamilton, of Waterford, Mississippi, kindly consented, with the full approval of the pedestrian, Mr. Henry Schmehl, and of his banker, Mr. Dick Sims, to superintend the rigid collection of the urine excreted up to the moment of the termination of the walk.

I furnished the necessary glass vessels, and each day the entire amount of urine was transmitted by Dr. Hamilton to my Practical Laboratory, Medical Department University of Louisiana, corner Common and Baronne streets, 2d floor.

Dr. Hamilton informed me that Mr. Schmehl manifested great interest in the investigation, and was scrupulously exact in preserving the entire amounts of urine passed.

From 9½ o'clock p. m., February 6th, up to 11.45 a. m., February 7th, 1878, Schmehl walked 50 miles, and the pedestrian had therefore, up to the moment of the commencement of the collection of his urine, walked 230 miles, in a period of 61 hours and 41 minutes, including rests and periods consumed in eating. During this period he rested about 15 hours, making actually on the track 46.41 hours. Average number of miles per hour for entire time, including rests, 3.74; average number of miles per hour whilst on track, 4.95.

Amount of urine passed during 24 hours, from Thursday, February 7th, 11.45 a. m., to Friday, 8th, 11.45 a. m., 1500 cubic centimetres. Urine light brownish-yellow color; clear; no deposits; strong acid reaction. When boiled, the urine emitted bubbles of carbonic acid, and let fall a heavy white deposit,

which was entirely and promptly soluble in nitric acid, and which upon chemical examination proved to be not albumen, but the phosphates of lime, magnesia and ammonia. These phosphates were held in solution in the urine by carbonic acid, which was dissipated by heat. The excess of carbonic acid in the urine appears to have been derived from the porter and the seltzer water, which the patient took in considerable quantities.

Specific gravity of urine 1029.

1500 cc. of urine passed during 24 hours, February 7th, 11.45 a. m., to February 8th, 11.45 a. m., contained:

Urea	970.20 grains.
Uric acid	9.00 "
Phosphoric acid	75.07 "
Sulphuric acid	77.20 "
Chloride of sodium	171.88 "

Distance walked during the 24 hours in which the preceding 1500 cc. of urine were excreted (February 7th, 11.45 a. m., to February 8th, 11.45 a. m.), 85 miles.

Actual time on the track, 17 hours and 40 minutes; rested 6 hours and 20 minutes. Average number of miles per hour, including entire time of 24 hours, 3.54 miles. Average number of miles each hour whilst on track (17 hours 40 minutes) 4.8 miles.

Amount of urine excreted during 24 hours, Friday, February 8th, 11.45 a. m., to Saturday, February 9th, 11.45 a. m., 1650 cubic centimetres. Specific gravity 1025. Reaction acid. Urine turbid from slight deposit of urates and phosphates. Urine of a lighter color—reddish yellow. As before, the urine contained much carbonic acid, and let fall a heavy white deposit of the phosphates, when subjected to the action of heat. The urine is not so strongly acid as upon the preceding day.

1650 cc. of urine excreted during 24 hours (Friday, February 8th, 11.45 a. m., to Saturday, February 9th, 11.45 a. m.), contained:

Urea	914.76 grains.
Uric acid	13.20 "
Phosphoric acid	69.87 "
Sulphuric acid	49.76 "
Chloride of sodium	127.05 "

Distance walked during the 24 hours in which the preceding specimen of urine was collected (February 8th, 11.45 a. m., to

February 9th, 11.45 a. m.), 83 miles; on the track 17 hours and 20 minutes; rested 6 hours and 40 minutes. Average number of miles during the entire period of 24 hours, 3.45 per hour; average number of miles each hour during active exercise, 4.83.

Total distance walked up to 11.45 a. m., February 9th, 398 miles; it was therefore necessary that the pedestrian should still walk 102 miles to complete the 500 miles in the stipulated time.

Amount of urine passed during 24 hours, February 9th, 11.45 a. m., to February 10th, 11.45 a. m., 1715 cc. Urine of lighter color—deep yellow. It is not only more abundant, but is of less specific gravity, and its reaction is neutral. Specific gravity 1022. These changes in the urine appear to be due to the more free use by the pedestrian of porter, champagne, and seltzer water. When boiled, heavy white deposit of phosphates, soluble in nitric acid.

1715 cc. of urine passed during 24 hours (February 9th, 11.45 a. m., to February 10th, 11.45 a. m.), contained:

Urea	789.02 grains.
Uric acid	12.00 "
Phosphoric acid	47.20 "
Sulphuric acid	53.00 "
Chloride of sodium	78.90 "

There was an evident flagging of the powers of the pedestrian during the 24 hours just specified, as the fifth hundred miles were completed in 32 hours 51 minutes and 25 seconds, whilst the preceding fourth hundred miles were completed in 29 hours 4 minutes and 20 seconds.

Schmehl completed the walk of 500 miles at 7.21 o'clock p. m., this day, February 10th.

The entire time consumed in walking the 500 miles, was 142 hours 17 minutes and 5 seconds.

Amount of urine passed (during 7 hours and 36 minutes) from 11.45 a. m. to 7.21 o'clock p. m., February 10th, 1475 cubic centimetres. Light yellow color; slightly turbid. Light deposit of urates. Reaction neutral. Specific gravity 1023. Heat drove off the excess of carbonic acid and caused a precipitate of the phosphates, as in preceding specimens.

1475 cc. of urine passed during 7 hours and 36 minutes (11.45 a. m., to 7.21 p. m., February 10th), contained:

Urea	601.80 grains.
Uric acid	7.35 "
Phosphoric acid	30.10 "
Sulphuric acid	43.05 "
Chloride of sodium	111.82 "

It is evident from the results of the preceding analysis, that the excretion of the urinary constituents was greatly increased during the last portion of the walk of 500 miles; and such increase appears to be clearly referable to nervous excitement, and increased exertions in the presence of the large audience assembled in St. Patrick's Hall to witness the conclusion of the remarkable performance. During the last hour of the walk the pedestrian was continuously cheered by the audience, and he appeared to summon all his energies to complete the self-imposed task.

That there was no diminution in his exertions, is evident from the following record of the last 56 miles.

Miles.	Min.	Sec.	Miles.	Min.	Sec.	Miles.	Min.	Sec.
443	13	00	464	12	50	483	12	10
444	12	00	465	12	30	484	13	00
445	12	50	466	12	25	485	14	00
446	12	10	467	12	00	486	13	50
448	12	00	468	12	05	487	12	00
449	12	05	469	12	10	488	13	20
450	12	50	470	12	00	489	12	00
451	12	10	471	12	45	490	13	20
452	11	50	472	13	05	491	12	10
453	11	45	473	13	30	492	10	05
454	11	55	474	14	00	493	10	10
456	13	00	475	14	05	494	11	30
457	13	30	476	15	00	495	11	00
458	13	45	477	14	20	496	11	00
459	12	50	478	13	50	497	12	30
460	12	35	479	13	00	498	11	30
461	13	00	480	13	05	499	12	00
462	13	00	481	13	10	500	11	25
463	13	10	482	11	10			

In the following table is given the time in which each 100 miles was finished, the actual walking time and periods of rest, the speed per hour, together with some observations made by his attendant physician* upon the variations of the pulse, respiration and temperature.

* Dr. L. A. Estrampes.

FIRST 100 MILES.

	Hours.	Min.	Sec.
Full time.....	23	11	5
Actual walking time....	17	24	38
Aggregate resting time..	5	46	27
Average time per mile..		10	27

Average miles per hour, 5.71.

SECOND 100 MILES.

	Hours.	Min.	Sec.
Full time.....	29	30	25
Actual walking time....	19	4	30
Aggregate resting time..	10	25	55
Average time per mile..		11	26

Average miles per hour, 5.20.

THIRD 100 MILES.

	Hours.	Min.	Sec.
Full time.....	27	40	40
Actual walking time....	18	30	38
Aggregate resting time..	9	10	2
Average time per mile..		11	

Average miles per hour, 5.40.

FOURTH 100 MILES.

	Hours.	Min.	Sec.
Full time	29	4	20
Actual walking time....	19	53	3
Aggregate resting time..	9	11	17
Average time per mile..		12	45

Average miles per hour, 5.

FIFTH 100 MILES.

	Hours.	Min.	Sec.
Full time.....	32	51	25
Actual walking time....	20	39	13
Aggregate resting time..	12	12	13
Average time per mile..		12	13

Average miles per hour, 4.9.

PULSE RESPIRATION AND TEMPERATURE.

During the entire walk there was little or no perspiration. The respiration varied from 18 to 19½ per minute; and the temperature under the tongue from 98 to 98.75° F. On the first night before walking, his pulse was 82; after walking steadily without extra exertion, it rose to 98, and then, upon great exertion in walking rapidly around the track for some minutes, it rose to 108. After resting, the pulse fell to 96.

On the second day the pulse ranged from 92 to 96, except during unusual exertion, when it rose to 116. After resting three and a half hours, and sleeping one hour and a half, it fell to 85.

On the third day, the pulse ranged during exercise from 98 to 112, and after rest it fell to 82.

On the fourth day, Schmehl took his first bath, and after resting his pulse fell to 78, and rose to 98 during walking.

On the last day he commenced with a pulse of 82, which increased during exercise to 92, and after sleep fell to 72. It ranged from 84 to 106. At the end of the last mile the pulse was 100.

The following are the variations of the Pulse, Respiration, and Temperature, during the period in which the urinary secretion was examined.

February 7th.—Pulse, 96–126; respiration, 18–22; temperature, 98–100°.

February 8th.—Pulse, 86–106; respiration, 19–22; temperature, 98°–98.8°.

February 9th.—Pulse, 75–102; respiration, 18–20; temperature, 98°–98.5°.

February 10th.—Pulse, 78–106; respiration, 18-21; temperature, 98.5°–99°.

Total time consumed by Schmehl in walking 500 miles, 142 hours 17 minutes and 5 seconds.

Aggregate time walked, 95 hours 32 minutes and 3 seconds. Aggregate time rested, 46 hours 45 minutes and 3 seconds. When the last mile was finished, the pedestrian had 42 minutes and 5 seconds to spare, and had consumed on an average about 11½ minutes to each mile. The fastest mile was the first, which was made in eight minutes; the slowest was about sixteen and a half minutes. He actually walked about eighty-three and one-third miles a day.

It is said that O'Leary, in April, 1877, walked in London 500 miles in 134 hours 43 minutes and 20 seconds, and 519 miles in 140 hours 29 minutes and 50 seconds, being matched against Weston.

Schmehl consumed about one and a half pounds of rare beef steak, and one and a half quarts of fresh beef tea, and half a dozen raw eggs daily; and in addition, drank freely of porter, champagne and seltzer water. His limbs were rubbed twice daily with aromatic liniment.

The prolonged exertion was productive of no ill effects, and the next day after the completion of his 500 miles walk, he drove out to the lake with his friends.

General Results.

The preceding investigation adds another demonstration to the doctrine that increased muscular exertion is attended with increased secretion of urea, phosphoric acid, and sulphuric acid.

Schmehl excreted in the 24 hours ending February 7th, 11.45, nearly one thousand grains, or more exactly 970.20 grains of urea, 75.07 phosphoric acid, and 77.26 grains sulphuric acid. On the following day there was only a slight diminution of these constituents; and during the 24 hours ending February 10th, 11.45 a. m., only 789.02 grains of urea. 47.20 of phosphoric acid, and 53.0 grains of sulphuric acid were excreted. But even the last amounts are far in excess of those usually excreted by active, well-fed muscular men.

A great increase of urea and of phosphoric and sulphuric acids was, however, witnessed during the last seven and a half hours of the walk, during which short period the extraordinary quantities of 601.80 grains of urea; 30.10 grains phosphoric acid, and

43.05 sulphuric acid were excreted. An equal rate of excretion for 24 hours would have given about 1865.48 grains urea, 90.50 grains phosphoric acid, and 137.76 grains of sulphuric acid.

AMOUNTS OF UREA EXCRETED BY ADULT MEN UNDER VARIOUS CONDITIONS OF REST, EXERCISE, AND VARIATIONS OF FOOD.

The estimates by various observers, as to the average amount of urea excreted during twenty-four hours by adult men, vary within wide limits; but the variations may, however, be reconciled by referring them to the differences of methods of analysis, and to the different circumstances and conditions of rest, exercise and food. Becquerel estimated the amount of urea excreted by healthy adults at from 225 to 270 grains in twenty-four hours. Golding Bird placed the average amount excreted by healthy men during twenty-four hours at 270 grains. The following are the results deduced by M. Lecanu from a series of 120 analyses.

	Maximum grains.	Mean grains.	Minimum grains.
Adult men	510.36	433.13	357.5
Adult women	437.15	295.15	153.2
Old men (84 to 86 years)	295.15	125.22	61.0
Children of eight years	254.20	207.99	161.7
Children of four years	81.83	69.55	75.2

According to Lehmann, a healthy man excretes during 24 hours from 340 to 600 grains of urea. This physiologist obtained the following results from experiments upon himself.

Urea Excreted in Twenty-four Hours.

Mixed diet	501.76 grains.
Animal diet	821.37 "
Vegetable diet	347.10 "
Non-nitrogenous diet	337.90 "

In the first series of experiments, Professor Lehmann adopted an ordinary mixed diet, and took no more solid or liquid aliment than was needed to appease hunger and thirst, and abstained from fermented drinks. Every two hours he took exercise in the open air, but avoided immoderate exercise of every kind.

The result given upon the first line represents the average amount of urea passed, under these circumstances, for fifteen days.

In the second set of experiments, Professor Lehmann lived for twelve days on an exclusively animal diet, which during the last six consisted solely of eggs. He took thirty-two eggs daily, which contained 2929 grains of dried albumen, and 24.31 grains of fatty matter, or about 3532 grains of carbon, and 465.5 grains of nitrogen. From the table it is seen, that the urea increased from 501.76 grains to 821.37 grains, and contained more than five-sixths of the whole amount of nitrogen ingested.

In the third set, the experimenter lived upon a vegetable diet, and during this period the average daily amount of urea fell to 347.10 grains.

In the fourth set, the diet consisted entirely of pure farinaceous and oleaginous substances, so that the azotized matter of the urine (urea) must have been solely the result of the disintegration of the tissues, and it is seen to have undergone a rapid and marked diminution, for this diet was used only two days: the health of Professor Lehmann was so seriously affected that he was unable to continue the diet longer.

Dr. John C. Draper found the average quantity of urea excreted during 24 hours to be 408 grains. Bischoff places the average for adult men at 540 grains.

The average daily amount of urea excreted by adult males, between twenty and forty years of age, has been given at the following figures by the different observers: Parkes, 371.5 grains; Benke, 378.2; Scherer, 416.8–460.4; Moos, 444.6; Böcker, 444.9; Schneller, 458.2; Neubauer, 511.2; Kaupp, 535.1 J. Vogel, 540.0; V. Franque, 541.3; Beigel, 551.0; Mosler, 558.9; Rummel, 563.6–605.2; Kerner, 588.2; Ranke, 656.0; Hammond, 670.6; Gentle, 517.4; Warnecke, 520; Haughton, 575.8 grains.

Dr. Edmond A. Parkes, in his work on "*The Composition of the Urine in Health and Disease, and under the Action of Remedies*," gives as the mean result of numerous analyses of urine in adult males between twenty and forty years of age (the mean in the analyses being generally drawn from more than six, and often ten to twenty days), as 512.4 grains during twenty-four hours.

Dr. Thudichum, in his work on the *Pathology of the Urine*, affirms that numerous experiments have shown that a healthy

man, who lives well, discharges from 30 to 40 grammes (463 to 617 grains) of urea in twenty-four hours.

The discrepancies in these results are referable chiefly to differences of chemical processes, and in the diet and modes of living of the subjects of the experiments. Thus the process employed by Becquerel (the separation of the urea as a nitrate) yields lower results than the volumetric method of Liebig, which was employed by most of the observers whose results have just been presented, and which method was also employed by myself in the analysis of the urine of Schmehl. In addition to this, the subjects of Becquerel's experiments were Frenchmen, who, from their size and diet, appear to yield less urine than Englishmen, and probably also than the Germans.

Professor Lehmann, according to his statement of the amount of food consumed during his investigations, evidently excreted more urea than usual; and the average founded upon his experiments would be somewhat higher than the average with Americans. The digestive powers of a man who could dispose of 32 eggs daily, must surely be far above those of ordinary men in civilized life in this country.

If we adopt the standard of Dr. Thudichum, which is full high for Americans, then Schmehl excreted, during his prolonged muscular exertions, nearly double the amount of urea ordinarily excreted by well-fed and active men. The increased amount of urea in the urine of Schmehl was clearly referable to the muscular exertion required to execute on an average a journey of 83½ miles in 24 hours.

In starvation, it is well known that the urea is greatly diminished in the urine, and may fall as low as 120 grains in the 24 hours.

On the other hand, as I have shown by numerous recorded observations, in certain diseases, as pneumonia and typhoid fever, small-pox, hospital gangrene, pyæmia, remittent fever, malarial hæmaturia, and yellow fever, the urea may range from 600 to 1250 grains in the 24 hours; and that, too, whilst the patients were taking little or no food, and were in a state of almost absolute starvation. In yellow fever, when the kidneys perform their normal functions, and when there is no abnormal alteration of these organs and diminution of their excretion, I have observed the urea to range from 600 to 1000 grains in 24 hours.

In other words, in certain diseases, and especially in typhoid fever and yellow fever, the waste of the tissues in a state of almost absolute starvation is greater than those of a well-fed pedestrian who walks 83½ miles per day, and completes 500 miles in a little over 142 hours.

In such facts we have a powerful argument for the theory, that febrile poisons are related in a definite manner to the chemical constituents of the blood and organs and tissues.

Such results place in the clearest light the absurdity of those theories which would locate the origin and nature of fever solely in the cerebro-spinal and sympathetic nervous system. Without doubt the nervous system suffers in fever, and manifests its peculiar phenomena and disordered acts when affected by morbific agents; but the blood and muscular tissues and other organs suffer in a similar degree.

The fever patient, therefore, actually generates an amount of physical force and loses correspondingly an amount of matter, equivalent to the muscular and nervous force requisite to achieve a walk of 100 miles in 24 hours.

Is there, then, in the light of such facts, any obscurity about the cause of the wasting and utter muscular and nervous exhaustion induced by the action of febrile poisons?

In the case of Schmehl, the chemical acts of the waste of organic material resulted in the production of mechanical force—muscular and nervous force. In the fever patient we have the elevated temperature, rapid respiration, rapid circulation, and aberrated muscular and nervous forces. The chemical changes take place in the essential fevers, in the wrong positions and in uncontrolled amounts, and accomplish no useful mechanical results. We have in such facts, also, when coupled with the mode in which Schmehl sustained his muscular and nervous forces by beef tea and nutritious diet, and alcoholic stimulants, a strong argument in favor of the practice of those physicians who sustain the strength and chemical acts of their patients, in fever, by such easily assimilated diet as beef tea, milk and wine.

Amount of Phosphoric Acid Secreted by Adult Men under Various Conditions.

Dr. Breed, from thirty examinations of urine of four healthy

persons, determined the average daily amount of phosphoric acid to be grains 57.44; Neubauer, in the first individual, grains 47.86; in the second individual, grains 24.70; average for 24 hours, grains 36.28; Mosler, first series, 37.05; second series in the same individual, grains 57.12; average, grains 45; Dunblkenburg grains 32.94; Kaupp, 35.46; Bencke, 39.21; Ranke, 41.53; Aubert, grains 43.23. The mean of twenty-five sets of observations collected by Dr. Parkes, was 48.8 grains a day.

Dr. William Hammond determined the amount of phosphoric acid excreted by himself, under different circumstances of increased and diminished intellectual labor and the use of tea and coffee. During these experiments Dr. Hammond lived generously, as he says: "During the twenty-four hours I consumed sixteen ounces of fresh beef (boiled and roasted), twelve ounces of bread, one ounce of butter, eight ounces of potatoes, and two drachms of common salt. In the same period I drank thirty-two ounces of water. No other food, solid or fluid, was taken into the system." Under ordinary exercise and intellectual work the average daily amount of phosphoric acid excreted during ten consecutive days was, grains 43.66; during a similar period, under increased mental exertion, grains 66.15; under diminished mental action, grains 25.10; when tea was used, grains 38.07; coffee, 43.94.

Abstinence from food, or from food containing phosphorus and its compounds, diminishes the amount of phosphoric acid in the urine, but does not, as in the case of chloride of sodium, cause its entire disappearance; for whilst a large portion of this acid excreted by the kidneys is derived from the portions of food which accomplish their offices without entering into the actual composition of the various structures, still the portion which varies according to definite laws, is derived from the changes of those structures, which normally contain phosphorus and its combinations, as the nerves and muscular structures. Thus Mosler found, during abstinence from food, that the phosphates of the urine sunk to half the ordinary quantity, whilst, on the other hand, under larger amounts of albuminous substances consumed as food, the amount of this constituent of the urine was doubled.

Schmehl excreted, during the three last days of his walk, respectively, 75.07 grains, 69.87 grains, and 47.20 grains of phosphoric acid; and during the last 7 hours and 36 minutes of the

500 miles, he passed in his urine the extraordinary quantity of 30.10 grains, or on an average 90.60 grains of phosphoric acid.

The increased excretion of phosphoric acid in the case of the pedestrian, was clearly referable to the increased expenditure of muscular and nervous force.

I have shown, by numerous observations—

1st. That the amount of phosphoric acid varies with the nature of the disease.

2d. In intermittent fever, the excretion of phosphoric acid varies with the stage of the disease, being greatly reduced in the cold stage, and increased in the latter portion of the hot stage and commencement of the intermission. In a case of malarial hæmaturia the phosphoric acid, immediately after the restoration of the function of the kidneys, amounted to the extraordinary quantity of 120.12 grains in 24 hours, although the patient was in a state of almost complete starvation; and if the individual had been in a state of health and similarly deprived of food, this constituent of the urine would not have exceeded between ten and twenty grains.

3d. The amount of phosphoric acid excreted daily is increased in yellow fever (when the urinary excretion is not suppressed), in remittent fever, in typhoid fever, in small-pox, scarlet fever and measles; in hospital gangrene, dry gangrene, and pyæmia; in traumatic tetanus, and in inflammatory diseases of the cerebro-spinal nervous system, and in pneumonia and pleuritis.

Amount of Sulphuric Acid Excreted by Adult Men under Various Conditions.

If we accept the observations of Clare, Gruner, Neubauer, Parkes and others, and place the daily amount of sulphuric acid excreted by healthy men at between twenty and thirty-eight grains, with a mean of thirty-one grains, it is evident that in the case of the pedestrian Schmehl, this constituent of the urine was greatly increased, as he excreted upon the three last days of his walk, respectively, 77.26 grains, 49.76 grains, 53.00 grains; and during the last 7 hours and 36 minutes of the walk, 43.05 grains, or on an average 137.76 grains in 24 hours.

Recent investigations have not confirmed in all respects the observations of Berzelius and others, with reference to the

presence of sulphuric acid and sulphates in any considerable amounts in the juice of flesh; and they point to the kidneys and blood as the positions where these chemical changes are completed, in the final conversion of the sulphur of the albuminous compounds into sulphuric acid. The absence of sulphates from the juices of muscle may also be due to the constant passage of these salts from the muscular fibres into the blood, and the continuous and efficient elimination of the elements or compounds by the kidneys.

Whatever view we adopt with reference to the formation of sulphuric acid in the animal economy, it is evident that its increase, during the active stages of any disease, indicates an increased change of those nitrogenous elements which contain sulphur, and we must refer the increase of sulphuric acid in the urine of the pedestrian Schmehl to the same cause.